Geophysical Research Abstracts
Vol. 15, EGU2013-13652, 2013
EGU General Assembly 2013

Estimating vegetation vulnerability to detect areas prone to land degradation in the Mediterranean basin

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Vegetation is one of the key components to study land degradation vulnerability because of the complex interactions and feedbacks that link it to soil.
In the Mediterranean region, degradation phenomena are due to a mix of predisposing factors (thin soil horizons, low soil organic matter, increasing aridity, etc.) and bad management practices (overgrazing, deforestation, intensification of agriculture, tourism development).
In particular, in areas threatened by degradation processes but still covered by vegetation, large scale soil condition evaluation is a hard task and the detection of stressed vegetation can be useful to identify on-going soil degradation phenomena and to reduce their impacts through interventions for recovery/rehabilitation.
In this context the use of satellite time series can increase the efficacy and completeness of the land degradation assessment, providing precious information to understand vegetation dynamics.
In order to estimate vulnerability levels in Basilicata (a Mediterranean region of Southern Italy) in the framework of PRO-LAND project (PO-FESR Basilicata 2007-2013), we crossed information on potential vegetation vulnerability with information on photosynthetic activity dynamics.
Potential vegetation vulnerability represents the vulnerability related to the type of present cover in terms of fire risk, erosion protection, drought resistance and plant cover distribution. It was derived from an updated land cover map by separately analyzing each factor, and then by combining them to obtain concise information on the possible degradation exposure.
The analysis of photosynthetic activity dynamics provides information on the status of vegetation, that is fundamental to discriminate the different vulnerability levels within the same land cover, i.e. the same potential vulnerability. For such a purpose, we analyzed a time series (2000-2010) of a satellite vegetation index (MODIS NDVI) with 250m resolution, available as 16-day composite from the NASA LP DAAC dataset. Vegetation activity trends were estimated and then normalized to the starting conditions to obtain the percentage variation (NDVI-PV) for the considered period.
Information on the potential vulnerability and vegetation activity dynamics were classified into indexes and combined to obtain the final map of the actual vegetation vulnerability and to identify on-going degradation phenomena and priority sites within areas already compromised.
As for the investigated area, this map shows a composite picture in which only a few values of high vulnerability are scattered along areas where medium-high vulnerability values generally prevail. Here, we singled out two kind of areas: one largely devoted to intensive agriculture, and other one mostly characterized by bare soils and sparse vegetation. On the contrary, a large part of natural and seminatural vegetation located along the Apennine chain does not show critical vulnerability values.
By comparing the vegetation vulnerability map with the vulnerability map due to anthropic factors (pressure induced by agricultural and grazing activities, estimated by indicators derived from census data), we found correlation, confirming the anthropogenic cause of vulnerability and therefore the major role held by soil management in areas mainly devoted to intensive farming.